MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

ECE3286 – DIGITAL IMAGE AND VIDEO COMPRESSION

(ME)

31 MAY 2017
9.00 a.m - 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) A smartphone manufacturer decided to double its next generation flagship device's resolution, from the current 1920x1080 to 3840x2160. The display size of the smartphone remains the same at 5 inches. Comment on this, in terms of the impact on visual quality.

[4 Marks]

(b) Why is different sensitivity considered an important human visual perception feature in video compression? Relate the different sensitivity in human visual perception to image and video compression.

[5 Marks]

(c) Figure 1 below shows the general block diagram of a typical image and video compression systems. Relate the relationships between c and x for lossy compression systems.

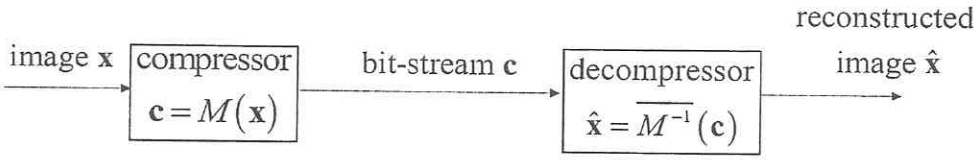

Figure 1: Typical Image and Video Compression Block Diagram.

[3 Marks]

(d) Differentiate the main difference between Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT).

[4 Marks]

(e) Describe in detail the two processes in a typical image and video compression system that make use of different sensitivity of human visual perception.

[9 Marks]

Question 2

(a) Briefly describe the lossless compression method used in a typical lossy image/video compression system.

[3 Marks]

(b) Suppose the entropy for an image is 7 and you have designed a Huffman Code for the image, with an average symbol length of 6.5 bits/symbol. Give some comments on this Huffman Code

[4 Marks]

Continued...

(c) Explain, with the aid of an appropriate diagram, the midtread quantizer. What is the reason why the midtread quantizer is used in the quantization process of a typical image/video coding system, rather than a midrise quantizer?

[10 Marks]

(d) What causes the blockiness effect in a typical image/video coding system? Propose three solutions that can reduce the blockiness effect.

[6 Marks]

(e) Explain whether the transform process in a typical video compression system is a lossless or a lossy process.

[2 Marks]

Question 3

(a) State the main difference between sequential coding and progressive coding in a Joint Photographic Experts Group (JPEG) image.

[3 Marks]

(b) The JPEG lossless mode is used to compress several images. Explain why the resultant bitrate of the images are different.

[4 Marks]

(c) The proliferation of smartphones and tablet computers with different screen sizes and processing capabilities in recent years enables us to access the online social network Facebook anywhere and anytime. Suggest how Facebook can make use of the scalability function of a JPEG-2000 image.

[5 Marks]

(d) There are three types of redundancies exploited in lossy JPEG image compression standard. Which type of redundancy causes JPEG to be a lossy image compression standard? Explain your reason.

[5 Marks]

(e) DC coefficients in a lossy Joint Photographic Experts Group (JPEG) image are coded using the Differential Pulse Code Modulation (DPCM) method. Suggest an explanation why DPCM is used.

[4 Marks]

(f) One of the advantages of JPEG-2000 image compression standard, compared with JPEG image compression standard is JPEG-2000 offers higher compression ratio. Describe another major advantage of JPEG-2000 image compression standard, compared with JPEG image compression standard.

[4 Marks]

Continued...

Question 4

(a) In an H.264 video coder, let there be two *B* frames between each non-*B* frame, and let the Group of Pictures (GOP) size be 15. At the source, we denote the frames in one GOP as follows:

$$I_1\ B_2\ B_3\ P_4\ B_5\ B_6\ P_7\ B_8\ B_9\ P_{10}\ B_{11}\ B_{12}\ P_{13}\ B_{14}\ B_{15}$$

i) What is the order in which the frames must be coded? Justify your answer. [4 Marks]

ii) What is the order in which the frames must be decoded? Justify your answer. [4 Marks]

(b) Exhaustive search motion estimation technique is usually not used in practical environment due to its high computational complexity. With the aid of an appropriate diagram, suggest and explain a technique which is able to reduce the computational complexity of exhaustive block matching significantly. [9 Marks]

(c) H.264 video coding standard introduces multiple reference frames technique for motion estimation and compensation process. Analyze the pros and cons of multiple reference frames technique. [4 Marks]

(d) H.264 video coding standard introduces block sizes of 4x4. What are the advantages of using a block size of 4x4, in comparison with a block size of 16x16? [4 Marks]

End of Paper